

Claims

1. A method and plant for the production of microcapsules for the immobilisation of chemical active substances, proteins, living cells, and/or micro organisms on an industrial scale,
characterised in that
the material to be encapsulated is solved, suspended, or emulsified in a liquid which cannot be mixed with water and in this form is delivered from a mixing tank into a reactor where pellets are produced therefrom in a coacervate process, which seal the material and which subsequently may be coated in the same and/or another vessel by repeated flushing with appropriate reagents which are supplied from various reservoirs.
2. The method according to Claim 1,
characterised in that
it comprises several or all of the following steps which may also be repeated several times:
 - solving, suspending, or emulsifying the material to be encapsulated in a basic substance which cannot be mixed with water;
 - delivering this basic substance, i. e. suspension, emulsion, or solution into a reaction vessel;
 - emulsifying of this suspension, emulsion, or solution at an increased temperature in a further liquid mixture which contains e. g. gelatine, water, and glycerine;
 - metering of an enveloping solution e. g. of Na alginate to the now solution;
 - lowering the temperature of the new mixture;
 - metering a reagent, e. g. calcium chloride, which precipitates the enveloping solution (e. g. alginate);
 - precipitating the drops;
 - rinsing and suspending the pellets which have been generated by the precipitation in a washing liquid;
 - flushing of the pellets with a polycationic polymer solution and forming a cationic charge on the pellet surface;
 - washing of the pellets in washing liquid;
 - washing of the pellets in a detergent solution;
 - flushing of the pellets with an polyanionic polymer solution and forming an anionic charge on the pellet surface;

- rinsing and suspending the pellets which have been generated by precipitation in a washing liquid;
- separating the pellets from the surrounding liquid medium;
- drying of the pellets.

3. The method according to Claims 1 and 2, characterised in that the basic substance is a fat or an oil.

4. The method according to Claims 1 to 3, characterised in that the material to be encapsulated/the basic substance, i. e. suspension, emulsion, or solution is conveyed by a mechanic means, preferably a worm conveyor or a pump, into a reaction vessel.

5. The method according to Claims 1 to 4, characterised in that the material to be encapsulated/the basic substance, i. e. suspension, emulsion, or solution is conveyed pneumatically into a reaction vessel.

6. The method according to Claims 1 to 5, characterised in that the drops in the phase which cannot be mixed with water contain the material to be immobilised.

7. The method according to Claims 1 to 6, characterised in that the drops are coated with enveloping material by precipitation.

8. The method according to Claims 1 to 7, characterised in that this enveloping reagent is an alginate salt.

9. The method according to Claims 1 to 8, characterised in that

the enveloped drops are maintained in suspension in the reaction solutions.

10. The method according to Claims 1 to 9,
characterised in that
the enveloped drops are maintained in suspension in the reaction solutions by agitating.

11. The method according to Claims 1 to 10,
characterised in that
the enveloped drops are maintained in suspension in the reaction solutions by the flow rate
of the surrounding medium.

12. The method according to Claims 1 to 11,
characterised in that
the enveloped drops are coated by flushing with suitable polymer solutions.

13. The method according to Claims 1 to 12,
characterised in that
the enveloped drops are maintained in suspension during coating.

14. The method according to Claims 1 to 13,
characterised in that
the enveloped drops are maintained in suspension during coating by agitating.

15. The method according to Claims 1 to 14,
characterised in that
the enveloped drops are maintained in suspension during coating by the flow rate of the
surrounding medium.

16. The method according to Claims 1 to 15,
characterised in that
the coated pellets comprise an envelope which completely seals the core and the en-
capsulated material.

17. The method according to Claims 1 to 16,
characterised in that

the envelope of the coated pellets consists of one or more radially arranged layers.

18. The method according to Claims 1 to 17,
characterised in that
layers of the envelope may be zones of different density.

19. The method according to Claims 1 to 18,
characterised in that
the coated pellets may be stored and used in the non-dried condition, i. e. in the moist
condition.

20. The method according to Claims 1 to 19,
characterised in that
the coated pellets may be freeze-dried.

21. The method according to Claims 1 to 20,
characterised in that
the coated pellets may be air-dried.

22. The method according to Claims 1 to 21,
characterised in that
solutions which are employed for precipitation and/or coating are used either as concen-
trates or in a ready to use diluted form.

23. The plant according to Claim 1 which operates in accordance with a method accord-
ing to Claims 1 to 22,
characterised in that
it comprises several of the following major components:

- mixing/emulsifying tank (EG) for the basic substance which cannot be mixed with
water and the material to be immobilised;
- mixing tank (WG) for the reactions solutions;
- reservoir (FB) for the precipitation reagent;
- reservoir (A) for the enveloping reagent;
- reservoir (E) for a washing solution, preferably a detergent;
- reservoirs (PK1, PK2, PA1, PA2, PA3) for the coating polymers;

- reaction-emulsifying vessel (FR) for the production of the particles;
- reaction vessel (BTR) for coating and separation of the enveloped particles;
- device for drying the coated pellets;
- heat exchangers (WT1, WT2) for temperature equalising of the reaction vessels;
- pumps (P1, P2, P3, P4) and valves (V1, V2, ...) for filling and draining the reaction vessels, as well as ball valves (KH1, KH2, KH);
- pneumatic valves and components;
- heating/cooling thermostats.

24. The plant according to Claim 23, characterised in that it operates according to Fig. 1 and/or its components are arranged and/or interconnected according to Fig. 1.